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INTEGRATED OBSERVATIONS OF SEMI-ARID LAND-SURFACE-ATMOSPHERE INTERACTIONS: POSTER SESSION OVERVIEW

B.F. Goff* and D.C. Goodrich
USDA-Agricultural Research Service, Tucson, AZ, USA.

1. INTRODUCTION

Semi-arid regions cover almost one-fifth of the world's land surface and are significant sources of food, fiber, habitat, and open space. They are important components of the global land-surface-atmosphere system, interacting with other components to influence global circulation patterns while simultaneously being affected by those patterns. Because of the complex and interdependent nature of global systems, global change research requires an integrated approach to observing land-surface-atmosphere interactions. The benefit of this approach is demonstrated in the many oral and poster presentations given as part of this Symposium. The purpose of this paper is to briefly highlight some of the major research themes occurring in the poster presentations in order to direct readers to posters and authors of particular interest

2. RESEARCH THEMES

For the purposes of this paper, poster presentations have been categorized according to 1) principal hydrometeorological process, 2) research approach, 3) principal measurement technique, 4) vegetation type, and 5) program or institutional affiliation. A summary of poster themes is presented in Table 1. A brief discussion of the themes is presented below. Note that all references cited here appear as poster presentations or papers within these Symposium Proceedings. Consequently, only the authors' names and presentation titles are provided.

2.1 Hydrometeorological Process

Surface fluxes (energy and water), evapotranspiration (ET), and plant transpiration are the principal hydrometeorological processes addressed in the poster presentations (e.g., Chehbouni et al. a & b, and Schaeffer and Williams). They represent interrelated components of the overall energy and water balance, and are differentiated here simply to indicate research emphasis. Subsidiary research on water source, stream-aquifer interactions, soil moisture, and plant growth was typically conducted to support these energy and water balance studies (e.g., Snyder et al., MacNish et al., Moran et al., and Nouvellon et al.). Most of these studies are part of larger global change research programs in the USA and Mexico. Notable exceptions are the work of Venencio and Garcia on droughts in Argentina, and the results presented by Gay a & b and others on the long-term ET inventory program in Arizona.

2.2 Research Approach

Research approach was categorized as either hydrometeorological or ecophysiological. Most investigators took a hydrometeorological approach to the research (e.g., Prueger et al., Whitaker et al.), that is, the emphasis was on the physical characteristics of the land-surface-atmosphere system rather than the ecological or biological characteristics. However, where the fundamental research question was ecological in nature rather than physical, an ecophysiological approach was used. This was the case for the water source research of Snyder et al., the sap flux research of Schaeffer and Williams, and the modeling work of Bégué et al. and Nouvellon et al.

2.3 Measurement Technique

For field experiments, researchers used a variety of standard atmospheric, hydrologic, and soil sensors and measuring devices to make direct measurements of hydrometeorological variables (e.g., MacNish et al., Scott et al.).

*Corresponding author address: Bruce F. Goff, USDA-ARS Southwest Watershed Research Center, 2000 E. Allen Road, Tucson, AZ 85719, USA; email: bgoff@tucson.ars.ag.gov

Table 1. Summary of poster presentation themes, session on Integrated Observations of Semi-Arid Land-Surface-Atmosphere Interactions.

Authors*	Hydrometeoro-logical Process	Research Approach	Measurement Technique	Vegetation Type	Program Affiliation
Bégué et al.	surface fluxes	ecophysio.	modeling	grassland	SALSA
Chehbouni et al. (a)	surface fluxes	hydromet.	remote sensing	grass/shrub steppe	SALSA
Chehbouni et al. (b)	surface fluxes	hydromet.	remote sensing	grass/shrub steppe	SALSA
Eichinger et al.	surface fluxes	hydromet.	remote sensing	riparian	SALSA
Gay (a)	ET	hydromet.	direct	irrigated crop	AZET
Gay (b)	ET	hydromet.	direct	riparian/orchard	AZET
Goff and Goodrich	ET	hydromet.	direct	riparian	SALSA
Goodrich et al.	ET	hydromet.	various	riparian	SALSA
Harlow et al.	surface fluxes	hydromet.	modeling	mixed	SALSA
Honaman et al.	ET, PET	hydromet.	direct	irrig. crop/shrub	AZET
Hymer et al.	soil moisture	hydromet.	direct	shrub steppe	SALSA
Konrad et al.	ET	hydromet.	modeling	irrigated crop	AZET
LeMone et al.	surface fluxes	hydromet.	direct	mixed	CASES-97
Lhomme et al.	transpiration	hydromet.	modeling	grass/shrub steppe	SALSA
MacNish et al.	stream-aquifer	hydromet.	direct	riparian	SALSA
Moran et al.	soil moisture	hydromet.	remote sensing	grass/shrub steppe	SALSA
Nouvellon et al.	plant growth	ecophysio.	modeling	grassland	SALSA
Pan et al.	ET	hydromet.	modeling	mixed	ISU
Prueger et al.	surface fluxes	hydromet.	direct	grass/shrub steppe	JER
Richardson et al.	ET	hydromet.	direct	irrigated crop	AZET
Schaeffer and Williams	transpiration	ecophysio.	direct	riparian	SALSA
Scott et al.	ET	hydromet.	direct	grass/shrub steppe	SALSA
Snyder et al.	water source	ecophysio.	direct (isotopes)	riparian	SALSA
Venencio and Garcia	drought	hydromet.	modeling	grass/shrub steppe	UNL
Watts et al.	surface fluxes	hydromet.	remote sensing	grass/shrub steppe	SALSA
Whitaker et al.	stream-aquifer	hydromet.	direct	riparian	SALSA
Yucel et al.	surface fluxes	hydromet.	remote sensing	mixed	SALSA

* See references list for citation. (Note: some poster presentations may not have a paper in this issue).

Others employed remote sensing technology to make indirect measurements of these variables. Remote sensing data were usually supplemented by direct measurements. The remote sensing techniques included satellite, aircraft, and ground-based radiometry, (Moran et al., Watts et al., Yucel et al.), lidar (Eichinger et al.), and scintillometry (Chehbouni et al. a & b, Watts et al.). In addition, a few studies employed computer modeling combined with existing data sets to simulate interaction among hydrometeorological processes. These include the modeling of grassland function (Bégué et al., Lhomme et al., and Nouvellon et al.), surface fluxes and ET (Harlow et al. and Konrad et al., Pan et al.), and drought (Venencio and Garcia).

2.4 **Vegetation Type**

Grasslands and shrub steppe represent the most extensive vegetation types examined in the poster studies. (e.g., Bégué et al., Hymer et al.,

Moran et al, Nouvellon et al., Prueger et al., Scott et al., Venencio and Garcia, Watts et al.). The riparian vegetation along the San Pedro River in SE Arizona and NE Sonora is an inclusion within the grassland and shrub steppe vegetation types. Riparian vegetation is highly susceptible to natural or human induced changes in the hydrologic regime. Consequently, several poster presentations focus on this critical issue (e.g., Goodrich et al., MacNish et al., Schaeffer and Williams, Snyder et al., Whitaker et al.). Other investigators examined ET from irrigated crops and natural vegetation in central and southern Arizona (Gay a & b, Honaman et al., Konrad et al., Richardson et al.). Studies listed as having a "mixed" vegetation type were typically those of a regional or continental nature.

2.5 **Program Affiliation**

The majority of studies summarized here were done as part of the Semi-Arid Land-Surface-Atmosphere (SALSA) Program, a multi-agency global change research effort led by the USDA Agricultural Research Service (e.g., Goff and Goodrich, Goodrich et al.). Similarly, the study by LeMone et al. was part of the CASES-97 global change research effort in SE Kansas and the work of Prueger et al. was part of the JORNEX campaign in New Mexico. Several other poster presentations describe results of the AZET program, a long-term ET inventory program of the Arizona Agricultural Experiment Station.

3. **CONCLUDING REMARKS**

This paper briefly summarized some of the important research themes discussed in the poster presentations of the Integrated Observations of Semi-Arid Land-Surface-Atmosphere Interactions session of this Symposium. It is hoped that this review will give readers a broader perspective of the breadth and depth of hydrometeorological research being conducted in semi-arid lands, and promote future cooperation in this kind of integrated research.

4. **ACKNOWLEDGMENTS**

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Chehbouni, A., R. Scott, O. Hartogensis, J-P. Lhomme, D.C. Goodrich, Y. Kerr, and H. De Bruin. (b) Examination of the relationship between radiative and aerodynamic surface temperature over heterogeneous surfaces.

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Gay, L.W. (b) Record rates of evapotranspiration from moist-site forest ecosystems in the Arizona desert.

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